Full wwPDB X-ray Structure Validation Report (i)

Feb 6, 2024 – 11:47 AM EST

PDB ID	:	2F6U
Title	:	Crystal Structure of (S)-3-O-Geranylgeranylglyceryl Phosphate Synthase complexed with citrate
Authors	:	Payandeh, J.
Deposited on	:	2005-11-29
Resolution	:	1.55 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at *validation@mail.wwpdb.org*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

The following versions of software and data (see references (i)) were used in the production of this report:

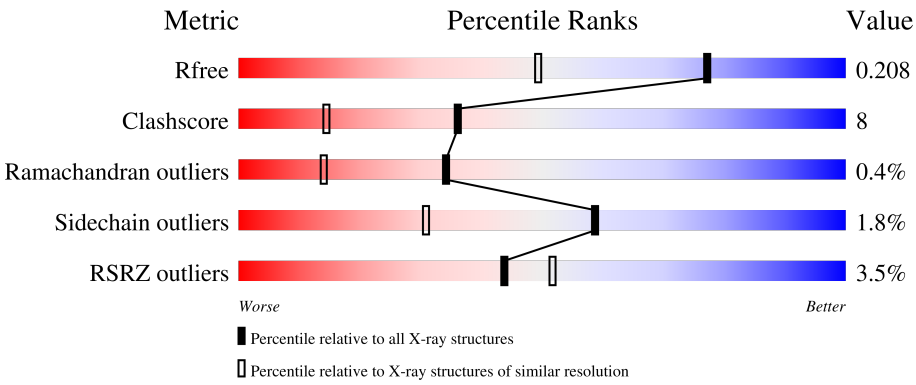
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.55 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	1483 (1.56-1.56)
Clashscore	141614	1529 (1.56-1.56)
Ramachandran outliers	138981	1498 (1.56-1.56)
Sidechain outliers	138945	1495 (1.56-1.56)
RSRZ outliers	127900	1465 (1.56-1.56)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions <=5% The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	234	4% 86% 11% • •
1	B	234	3% 82% 15% • •

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 4146 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

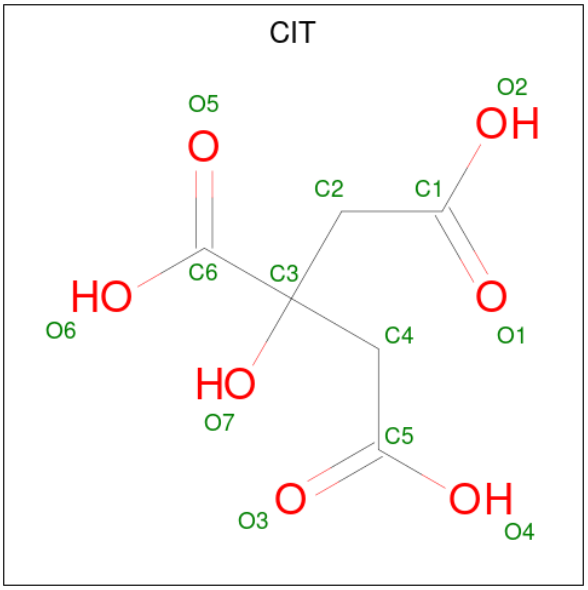
- Molecule 1 is a protein called (S)-3-O-Geranylgeranylglyceryl Phosphate Synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	231	1903	1220	313	365	5	0	8	0
1	B	231	1877	1200	312	360	5	0	4	0

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	998	GLY	-	cloning artifact	UNP O29844
A	999	SER	-	cloning artifact	UNP O29844
A	1000	HIS	-	cloning artifact	UNP O29844
B	1998	GLY	-	cloning artifact	UNP O29844
B	1999	SER	-	cloning artifact	UNP O29844
B	2000	HIS	-	cloning artifact	UNP O29844

- Molecule 2 is CITRIC ACID (three-letter code: CIT) (formula: $C_6H_8O_7$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
2	A	1	13	6	7	0	0
			Total	C	O		
2	B	1	13	6	7	0	0

- Molecule 3 is water.

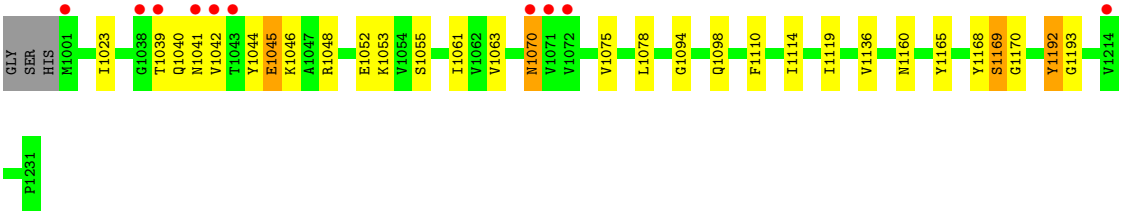
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	173	173	173	0	0
			Total	O		
3	B	167	167	167	0	0

3 Residue-property plots (i)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density (RSRZ > 2). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

- Molecule 1: (S)-3-O-Geranylgeranylglyceryl Phosphate Synthase

Chain A:



- Molecule 1: (S)-3-O-Geranylgeranylglyceryl Phosphate Synthase

Chain B:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	H 3	Depositor
Cell constants a, b, c, α, β, γ	95.24Å 95.24Å 166.62Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 1.55 73.92 – 1.42	Depositor EDS
% Data completeness (in resolution range)	(Not available) (50.00-1.55) 96.6 (73.92-1.42)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.17 (at 1.42Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.191 , 0.217 0.184 , 0.208	Depositor DCC
R_{free} test set	4992 reflections (4.90%)	wwPDB-VP
Wilson B-factor (Å^2)	17.4	Xtriage
Anisotropy	0.073	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 51.4	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.019 for h,-h-k,-l	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	4146	wwPDB-VP
Average B, all atoms (Å^2)	21.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.88% of the height of the origin peak. No significant pseudotranslation is detected.*

[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality (i)

5.1 Standard geometry (i)

Bond lengths and bond angles in the following residue types are not validated in this section: CIT

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\#\|Z\| >5$	RMSZ	$\#\|Z\| >5$
1	A	0.37	0/1941	0.67	0/2637
1	B	0.38	0/1915	0.65	0/2600
All	All	0.38	0/3856	0.66	0/5237

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	1192	TYR	Sidechain

5.2 Too-close contacts (i)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1903	0	1896	25	0
1	B	1877	0	1870	37	0
2	A	13	0	5	1	0
2	B	13	0	5	0	0
3	A	173	0	0	3	0
3	B	167	0	0	3	0
All	All	4146	0	3776	61	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 8.

All (61) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:2082[B]:THR:HG22	1:B:2096:HIS:HE1	1.10	1.09
1:B:2082[B]:THR:HG22	1:B:2096:HIS:CE1	1.96	0.99
1:B:2114:ILE:HD13	1:B:2119:ILE:HG13	1.67	0.77
1:A:1078:LEU:HB3	1:A:1119[A]:ILE:HD13	1.73	0.69
1:B:2001:MET:HB2	1:B:2117:GLU:OE2	1.96	0.66
1:B:2156:GLU:OE2	1:B:2157:LYS:HE2	1.97	0.64
1:A:1063:VAL:HG23	1:A:1075:VAL:HG11	1.81	0.63
1:A:1055:SER:HA	1:A:1061:ILE:HD11	1.83	0.60
1:B:2082[A]:THR:HB	1:B:2096:HIS:HE1	1.66	0.59
1:B:2001:MET:HE2	1:B:2117:GLU:HG3	1.85	0.59
1:B:2078:LEU:HB3	1:B:2119:ILE:HD13	1.87	0.56
1:B:2099:TRP:CH2	1:B:2114:ILE:HD11	2.40	0.56
1:A:1023[A]:ILE:HD12	1:A:1053:LYS:HE2	1.89	0.55
1:B:2048:ARG:O	1:B:2052:GLU:HG3	2.06	0.55
1:B:2199:ARG:HD3	1:B:2203:ARG:CZ	2.37	0.54
1:A:1098:GLN:HG2	3:A:251:HOH:O	2.07	0.54
1:A:1094:GLY:O	1:A:1098:GLN:HG3	2.09	0.53
1:B:2099:TRP:O	1:B:2103:HIS:HD2	1.91	0.53
1:A:1048:ARG:NH1	1:A:1052:GLU:OE1	2.42	0.52
1:A:1170:GLY:HA3	3:A:303:HOH:O	2.08	0.52
1:A:1048:ARG:O	1:A:1052:GLU:HG3	2.09	0.52
1:B:2001:MET:CB	1:B:2117:GLU:OE2	2.58	0.51
1:A:1110:PHE:CZ	1:A:1114:ILE:HD11	2.46	0.51
1:B:2001:MET:HG3	1:B:2003:TRP:HD1	1.75	0.51
1:B:2098:GLN:HG2	3:B:267:HOH:O	2.09	0.51
1:B:2001:MET:HB3	1:B:2004[A]:ARG:NH1	2.26	0.50
1:B:2013:ASP:HB3	1:B:2016:ARG:HG2	1.93	0.50
1:B:2091:TRP:CH2	1:B:2095:LYS:HE3	2.46	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:2108:GLN:O	1:B:2112:GLU:HG3	2.12	0.49
1:A:1039:THR:O	1:A:1042:VAL:HG12	2.13	0.49
1:A:1078:LEU:HD23	1:A:1119[A]:ILE:CD1	2.42	0.49
1:A:1160[A]:ASN:ND2	1:B:2160[A]:ASN:HB3	2.29	0.47
1:B:2004[B]:ARG:HB3	1:B:2004[B]:ARG:NH1	2.29	0.47
1:A:1110:PHE:CE2	1:A:1114:ILE:HD11	2.50	0.47
1:B:2001:MET:HB3	1:B:2004[A]:ARG:HH12	1.78	0.47
1:B:2001:MET:HG3	1:B:2077:TYR:OH	2.15	0.47
1:B:2156:GLU:O	1:B:2160[B]:ASN:HA	2.14	0.47
1:B:2203:ARG:NE	3:B:159:HOH:O	2.45	0.47
1:B:2091:TRP:CZ2	1:B:2095:LYS:HE3	2.50	0.47
1:A:1070:ASN:H	1:A:1070:ASN:ND2	2.13	0.46
1:B:2011:LYS:HE2	3:B:134:HOH:O	2.14	0.46
1:A:1193:GLY:HA3	2:A:3001:CIT:O4	2.16	0.46
1:B:2039:THR:OG1	1:B:2041:ASN:ND2	2.50	0.44
1:B:2132:ALA:O	1:B:2136:VAL:HG23	2.16	0.44
1:B:2168:TYR:O	1:B:2169[B]:SER:C	2.56	0.44
1:A:1023[A]:ILE:CD1	1:A:1053:LYS:HB3	2.49	0.43
1:B:2001:MET:HE3	1:B:2117:GLU:HB2	2.01	0.43
1:A:1045:GLU:OE1	1:A:1045:GLU:HA	2.19	0.43
1:A:1046:LYS:HD2	3:A:153:HOH:O	2.18	0.43
1:A:1070:ASN:H	1:A:1070:ASN:HD22	1.66	0.43
1:A:1044:TYR:CE2	1:A:1048:ARG:HD2	2.54	0.42
1:A:1114:ILE:HA	1:A:1119[B]:ILE:HD12	2.00	0.42
1:B:2003:TRP:HA	1:B:2006:TRP:CE2	2.55	0.42
1:B:2082[B]:THR:CG2	1:B:2096:HIS:HE1	2.03	0.41
1:B:2168:TYR:O	1:B:2169[A]:SER:C	2.56	0.41
1:B:2189:ARG:CZ	1:B:2210:ASP:HB3	2.50	0.41
1:B:2041:ASN:ND2	1:B:2041:ASN:C	2.72	0.41
1:A:1168:TYR:O	1:A:1169[A]:SER:C	2.58	0.41
1:B:2001:MET:HE3	1:B:2117:GLU:CB	2.51	0.41
1:A:1192:TYR:CD2	1:A:1192:TYR:C	2.95	0.40
1:A:1040:GLN:NE2	1:A:1136:VAL:HG11	2.37	0.40

There are no symmetry-related clashes.

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	A	236/234 (101%)	228 (97%)	6 (2%)	2 (1%)	19 4
1	B	233/234 (100%)	225 (97%)	6 (3%)	2 (1%)	17 3
All	All	469/468 (100%)	453 (97%)	12 (3%)	4 (1%)	34 3

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	1169[A]	SER
1	A	1169[B]	SER
1	B	2169[A]	SER
1	B	2169[B]	SER

5.3.2 Protein sidechains (i)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	A	208/202 (103%)	204 (98%)	4 (2%)	57 28
1	B	204/202 (101%)	201 (98%)	3 (2%)	65 37
All	All	412/404 (102%)	405 (98%)	7 (2%)	59 32

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1041	ASN
1	A	1045	GLU

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Mol	Chain	Res	Type
1	A	1070	ASN
1	A	1165	TYR
1	B	2041	ASN
1	B	2070	ASN
1	B	2165	TYR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	1040	GLN
1	A	1041	ASN
1	A	1070	ASN
1	A	1098	GLN
1	A	1108	GLN
1	B	2041	ASN
1	B	2070	ASN
1	B	2096	HIS
1	B	2103	HIS
1	B	2108	GLN
1	B	2216	ASN

5.3.3 RNA (i)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

2 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and

the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	CIT	B	3002	-	12,12,12	2.53	7 (58%)	17,17,17	2.50	6 (35%)
2	CIT	A	3001	-	12,12,12	2.37	7 (58%)	17,17,17	2.52	6 (35%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	CIT	B	3002	-	-	1/16/16/16	-
2	CIT	A	3001	-	-	0/16/16/16	-

All (14) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	3002	CIT	C3-C6	4.44	1.58	1.53
2	A	3001	CIT	C3-C6	3.98	1.57	1.53
2	B	3002	CIT	O3-C5	3.61	1.34	1.22
2	B	3002	CIT	O5-C6	3.43	1.33	1.22
2	A	3001	CIT	O3-C5	3.32	1.33	1.22
2	A	3001	CIT	O5-C6	3.09	1.32	1.22
2	A	3001	CIT	O4-C5	-2.84	1.21	1.30
2	B	3002	CIT	O4-C5	-2.79	1.21	1.30
2	B	3002	CIT	C2-C3	2.66	1.57	1.53
2	A	3001	CIT	O1-C1	2.66	1.31	1.22
2	B	3002	CIT	O1-C1	2.58	1.30	1.22
2	A	3001	CIT	C2-C3	2.34	1.56	1.53
2	A	3001	CIT	C4-C3	-2.25	1.51	1.53
2	B	3002	CIT	C4-C3	-2.18	1.51	1.53

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	3001	CIT	O5-C6-C3	-6.89	112.50	122.25
2	B	3002	CIT	O5-C6-C3	-6.77	112.66	122.25
2	B	3002	CIT	C3-C4-C5	3.41	122.07	113.81

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	3001	CIT	C3-C4-C5	3.36	121.94	113.81
2	A	3001	CIT	O6-C6-C3	3.03	118.31	113.05
2	B	3002	CIT	O7-C3-C2	-3.01	102.35	109.40
2	B	3002	CIT	C3-C2-C1	2.90	120.83	113.81
2	B	3002	CIT	O6-C6-C3	2.84	117.98	113.05
2	A	3001	CIT	O7-C3-C2	-2.82	102.81	109.40
2	A	3001	CIT	C3-C2-C1	2.79	120.58	113.81
2	B	3002	CIT	O2-C1-C2	2.14	121.21	114.35
2	A	3001	CIT	O2-C1-C2	2.07	121.00	114.35

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	3002	CIT	C4-C3-C6-O6

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	3001	CIT	1	0

5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

6 Fit of model and data (i)

6.1 Protein, DNA and RNA chains (i)

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q< 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å^2)	Q<0.9
1	A	231/234 (98%)	0.45	10 (4%) 35 40	9, 17, 39, 57	0
1	B	231/234 (98%)	0.34	6 (2%) 56 63	10, 18, 35, 55	0
All	All	462/468 (98%)	0.39	16 (3%) 44 52	9, 18, 37, 57	0

All (16) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1041	ASN	6.1
1	B	2001	MET	5.9
1	B	2041	ASN	5.9
1	A	1038	GLY	4.5
1	A	1039	THR	4.2
1	A	1042	VAL	4.1
1	A	1071	VAL	3.3
1	A	1043	THR	3.1
1	B	2002	ARG	3.0
1	B	2042	VAL	2.6
1	B	2170	GLY	2.5
1	A	1001	MET	2.4
1	A	1070	ASN	2.3
1	A	1072	VAL	2.3
1	B	2017	THR	2.3
1	A	1214[A]	VAL	2.3

6.2 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates (i)

There are no monosaccharides in this entry.

6.4 Ligands (i)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	CIT	B	3002	13/13	0.91	0.14	20,27,37,38	0
2	CIT	A	3001	13/13	0.94	0.13	16,19,25,26	0

6.5 Other polymers (i)

There are no such residues in this entry.